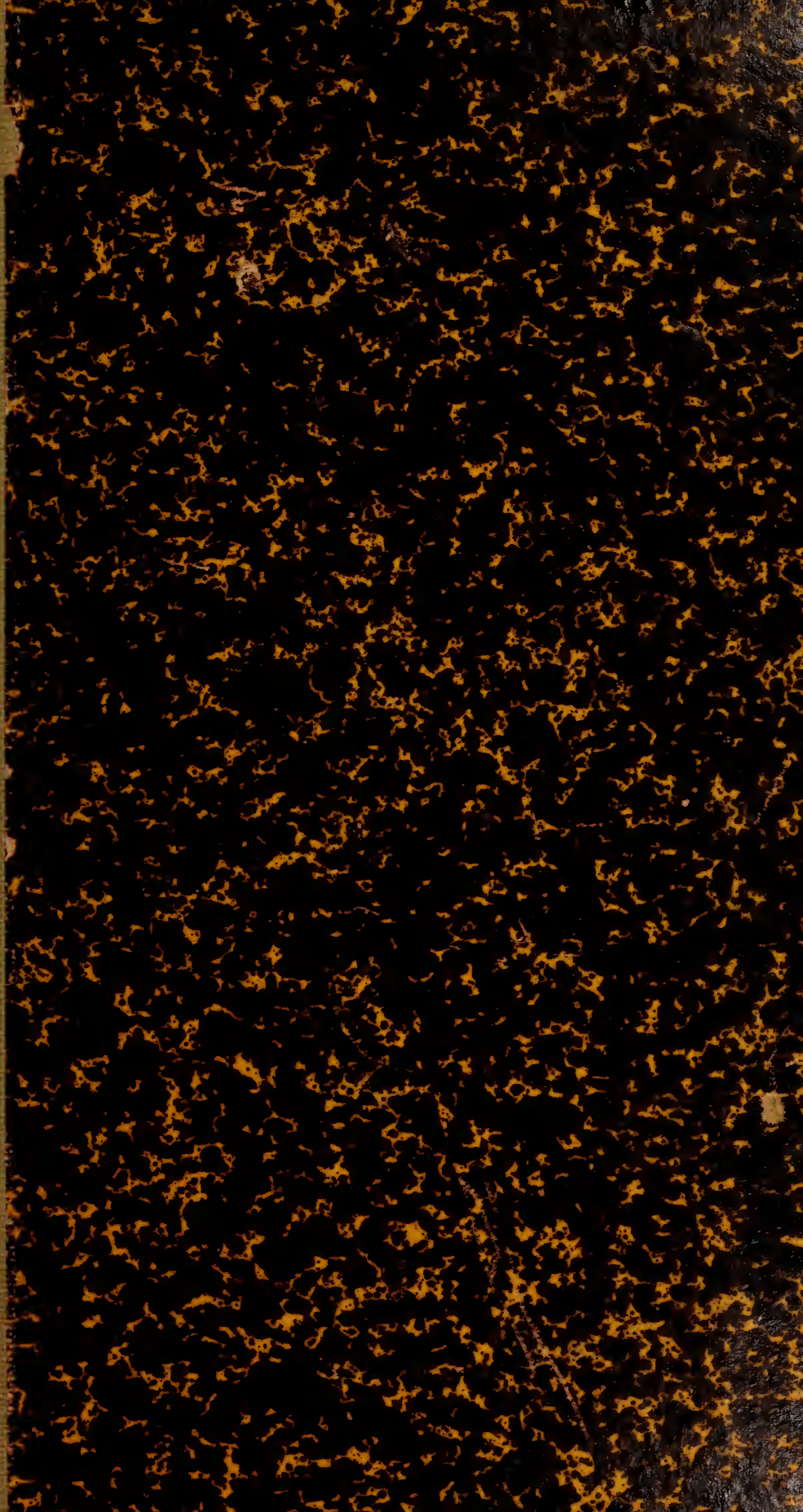




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BARRIER BEACHES OF THE ATLANTIC COAST.

BY FREDERICK J. H. MERRILL, PH. D.

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BARRIER BEACHES OF THE ATLANTIC COAST

BY

FREDERICK J. H. MERRILL, PH. D.

FROM Cape Cod to Cape Florida our coast is fringed with barrier beaches. They are the reefs of sand which protect the mainland shore from the storm-waves of the ocean. Isolated and uninhabited were most of these sea-born barriers for a long period in the history of our country, but the need of a breathing-place on the part of the thousands who inhabit our crowded cities has caused, within a few years, a great transformation. Railroad and turnpike bridges have been built, connecting many of them with the shore. Hotels and cottages, club-houses and bathing-houses, in short, buildings for every purpose which contributes to the pleasure and comfort of man have sprung up, as it were by magic, on the south shore of Long Island, on the coast

of New Jersey, Virginia, and the Carolinas, on the famed sea-islands of Georgia, and on the coast of eastern Florida.

Much alike are these peninsulas and islands wherever we view them along the coast. The chief variation is in the vegetation which clothes them. The beaches of Long Island are almost barren, but from New Jersey southward many are covered with dense forests which vary in their trees according to the latitude. At Sandy Hook, oaks, red cedars, hollies, maples, and sassafras-trees grow in wonderful luxuriance. On Seven-Mile Beach and Holly Beach the swamp magnolia abounds among the others. In the Carolinas the palmetto appears, often ragged in outline and blighted by the winter frosts. In northern Florida the palmettos are more numerous and show the influence of a warmer climate, while on the southern extremity of the zone of barrier beaches the cocoanut palm, planted by accident or design, rears its leafy crown in luxuriant verdure.

It is not the design of the writer to describe in detail the beaches of the Atlantic coast, but rather to consider their history and mode of growth. As it has been his fortune to spend much time on the sea-shore of New Jersey, he proposes to discuss the barrier beaches of that State as types of their genus.

They are sandy islands and peninsulas, from two to twenty miles in length and from half a mile to a mile in width, separated by inlets and usually divided from the mainland by an interval of several miles, in which are broad expanses of salt meadow, fringing and separating a series of channels, bays, and sounds.

The beaches which are now in their highest state of development are Sandy Hook, Seven-Mile Beach, and Holly Beach near Cape May. These typical examples of the sea-born barriers are much alike in structure, and consist of four principal divisions. The first division, or interior, is an undulating area covered with heavy timber, of which the size suggests its age. Immense hollies, oaks, pines, and red cedars abound, many of the first measuring two feet in diameter, and some of the latter attaining a circumference of four or five yards. The sassafras grows in remarkable luxuriance and immense grape-vines are everywhere to be seen, overhanging a dense undergrowth. In spring and summer the ground is covered with fragrant blossoms; columbines, violets, pinks, orchids, and a host of other flowers lend their bright colors to enhance the varied greens of the foliage. This is the beach primeval. Skirting it seaward is the second division, which bears smaller timber. Low cedars, hollies, and pines are here the chief forms of arboreal vegetation, and fewer flowering plants are seen. This zone is of later formation, and its trees are younger than those of the first. Adjoining it is the third division, which consists of a belt of undulating dunes a few hundred feet or yards

in width, and bearing the mossy *Hudsonia* or scrubby bushes of beach plum and wax-myrtle, or in some places, especially on the outer row of dunes, only supporting a meager growth of beach grass. Frequently, between two rows of dunes, an expanse of salt meadow occurs, or a sand flat bearing stunted forms of plant life. With this third division ends the domain of vegetation, succeeded by the sloping strand upon which the tide rises and falls. The sand-bar, exposed at low water at the extremity of the beach, is constantly increased in length and height by the action of the currents, and the process of beach formation is here continually in progress.

As the tide falls, the sand laid bare is rapidly dried by the wind and carried above high-water mark. Then, safe beyond the reach of the waves, the minute particles are borne still farther from the water, and striking against some piece of drift-wood, bush, or tuft of grass, quickly build a hillock, which grows larger and larger as more sand falls upon it, and a dune is formed many feet in height. The material of which these dunes are composed is never at rest, but flies hither and thither with the wind, and a hillock ten or fifteen feet high to-day may noiselessly be taken down to-morrow and rebuilt a hundred yards away. In time, as the beach grows seaward and the dunes increase in number, those of earlier formation, which are somewhat protected from the breeze, catch a few seeds, and tufts of grass begin to grow upon them. Still later, the mossy *Hudsonia* or some starveling wax-myrtle finds a little sustenance, and as years elapse the dunes become so thickly covered with vegetation that under the protection of the seaward hillocks they retain their form with comparatively little change.

Thus have the beaches grown. First a sand flat built by ocean waves and currents; then a series of low, shifting dunes; next sheltered hillocks, on which grasses and shrubs fasten their protecting roots; succeeding the latter a growth of small cedars and pines; and, finally, as centuries roll on, majestic forest trees raise their spreading tops and shelter a dense undergrowth.

These few words suffice to describe the beaches' growth, their physiology; but many pages might be written upon their history, the details of their development, their changes and their decay. Unfortunately, the records are but incomplete. From the memories of old men we can glean some facts in regard to the former condition and extent of certain beaches and concerning marked changes in them which have been notable events to men of quiet lives. In a few instances, surveys were made a century or two ago which can be compared with those of to-day. At present we can watch the changes which occur from year to year. As geological science advances we can speculate concerning the past on

the basis of present knowledge and observation. We have little accurate information, but, after all, we have much that is interesting.

The beach of Sandy Hook forms the northern extremity of the New Jersey sea-coast. Previous to 1778 it was connected with the base of the Navesink Highlands by a sandy isthmus, the mouths of the Navesink and Shrewsbury Rivers being open to the east; but from that date until about 1830, and from 1848 until 1889, it has been united with the mainland at Monmouth Beach by a narrow strip of sand.

According to records in the office of the Surveyor-General of East Jersey and in that of the United States Coast Survey, the point of Sandy Hook advanced northward about one mile between 1685 and 1885. The lighthouse was built about 1764 near the water's edge, and the ground on which it stands had then existed for only fifteen years as a portion of *terra firma*.

In 1844 the point was about two hundred and fifty yards north of its present limit. Since that date it has receded slowly toward the south, and toward the west has extended a quarter of a mile. We have no evidence concerning the date of formation of the old "Hook" which existed before 1685. It is now well marked by immense forest trees, which exceed in height and size of trunk any of their species known to the writer in the neighborhood of New York.

The rapid growth of Sandy Hook is due to a current which flows northward from the vicinity of Manasquan, carrying with it a great quantity of sand removed from the water front of Asbury Park, Long Branch, Seabright, and that vicinity, which is dropped along the border of the "Hook" and its extremity. The investigations of the United States Coast and Geodetic Survey have shown that the ebb and flow of the tides from and to New York Bay produce this current by drawing a stream of water through False Hook Channel, which lies between Sandy Hook and a submerged bar called False Hook half a mile to the east. The stream flows northward more than seven hours out of twelve, and from this fact property-owners in the neighborhood of Long Branch may appreciate what becomes of their real estate when it disappears during the storms. If there were any means of identifying the soil, it might all be found on the rapidly growing point of Sandy Hook.

About 1778 a channel was opened across the narrow isthmus which united Sandy Hook with the base of the Navesink Highlands, and a new passage being thus afforded for the tidal currents of the Navesink and Shrewsbury Rivers, the old Shrewsbury Inlet, which formed the common mouth of those two estuaries, was gradually closed by the northward extension of the sand-spit

which formed the southern limit, and in 1810 became impassable. The barrier thus formed existed until 1830 or 1831, when it was broken through and a second inlet was created. By a change in the tidal currents, due to the formation of this new inlet, the isthmus which formerly connected Sandy Hook with the Highlands of Navesink was again brought into existence and remained until 1835. An artificial channel was then cut through it, and this being gradually deepened and widened by the ebb and flow of the tides, has ever since remained open. The second Shrewsbury inlet closed in 1840 near Island Beach, having moved northward nearly three miles during its existence of nine or ten years. In 1837 or 1838 the third and last inlet opened near the present Bellevue Hotel, and afforded a better channel for navigation than the second inlet, which it followed in its northward course and survived by about eight years. From 1848 until September, 1889, no inlet has been opened; but this fact is due rather to the efforts of the railroad company to maintain its road-bed than to a diminution of the tendency of the waves and tidal currents to open a passage.

The facts and dates concerning the Shrewsbury Inlets have been obtained chiefly by inquiry from old fishermen and sailors who have spent their lives on or near the waters of the Navesink and Shrewsbury Rivers. Coming from a number of independent sources, they agree very closely, and those here given may be accepted as worthy of credence. The tendency of the inlets to work northward, periodically closing and reopening farther south, has been observed in all those between Point Pleasant and Sandy Hook, especially in those of Manasquan and Shark Rivers. Between Point Pleasant and Cape May, however, all the inlets are moving southward.

From Monmouth to the head of Barnegat Bay there is no beach similar to that of Sandy Hook. Instead of a sand-reef separated from the main land by a navigable channel, there is only the sloping strand adjoining, as at Long Branch, the foot of an upland bluff, or as at Spring Lake, Seagirt, and Point Pleasant, with its crest on a level with the surface of the upland. Between Bay Head and Cape May, however, there are twelve beaches, mostly well developed and preserved, and named respectively Squan, Island, Long, Island or Little, Brigantine, Absecon, Peck's, Ludlam's, Seven Mile, Five Mile or Holly, Two Mile, and Poverty. The majority of these, however, do not show the high degree of development exhibited by Seven-Mile and Five-Mile Beaches. Some appear to be only in the earlier stages of growth, while others have passed their prime and are now yielding to the attacks of wind and wave.

These agents have been hitherto considered only with reference

to their constructive effect on the beaches, and it now remains to consider their destructive action.

When the wind blows from the west it carries back to the sea much of the sand which the east wind had piled up in dunes, and, but for the fact that the latter wind prevails, the sand-hills would not long exist. By a surplus of constructive action, however, the beaches are all moving to the west. Year after year sand is removed from their eastern margin by the winter storms, and carried north or south according to the direction of the prevailing current. The winds from the ocean drive the dunes westward, and, with the possible exception of Sandy Hook, all the beaches are now underlaid by an old salt meadow, originally formed in sheltered waters on their west side. In this turf, when exposed during an unusually low tide, the footprints of cattle are seen in many places, made, it is claimed, when the salt meadow was a pasture and lay on the shoreward side of the beach. This westward recession has, in many cases, amounted to more than a mile within two centuries.

On many of the beaches south of Point Pleasant the westward progress of the dunes has been made over and through the native forest. As a result of this, gnarled cedars, dying and dead, are found among the dunes; and in many cases stumps may be seen in the sand within reach of the tide.

Near the northern end of Seven-Mile Beach, at the time of the writer's visit in 1885, an immense dune forty feet in height and half a mile in length had been for many years encroaching steadily upon the dense forest. The tree-tops here projected above the summit of the ridge like the heads of drowning men above the waves; while on the outer flank of the overwhelming mass of sand the gnarled, skeleton trunks of those which had perished in it stood bare and grim, showing with dreary grayness the fate of the earlier victims of which the ragged and wave-worn stumps alone remained. A more desolate scene the writer has never witnessed.

At Long Branch the wear of the coast has been very great. According to the United States Coast and Geodetic Survey, a strip of land varying from three hundred to five hundred feet in width was removed between Deal Beach and Monmouth during the twenty-seven years preceding 1868. In the vicinity of Seabright the amount of wear was a little less than two hundred feet during that period. Of late years the rate of recession has been diminished in the neighborhood of Long Branch by the means of artificial protection employed, but near Seabright the shore line is said to have receded at least two hundred feet during the past quarter of a century. At Cape May the wear of the shore has been continuous except where the land is protected by jetties or

a stone sea-wall, the rate of encroachment varying from ten to thirty feet a year.

Besides these alterations produced in the beaches by their westward progress, the variations in the positions of the inlets and the subsidence of the coast have caused many important changes. The history of the Shrewsbury Inlets has already been given; it remains to mention a few of those south of Point Pleasant.

Squan and Island Beaches, which now form a peninsula about twenty miles long, terminating at Barnegat Inlet, were separated from 1750 to 1812 by Cranberry Inlet, which was nearly opposite the mouth of Tom's River. Since 1812 near the site of this old inlet there have been others of brief duration, and one is said to have existed before 1755 opposite the mouth of the Metedeconk River, which separated Squan Beach from the mainland.

The old Barnegat Lighthouse is said to have stood nearly six hundred yards north of the present south shore of the inlet, at a point now occupied by the center of the channel. In 1855 the old tower was at the water's edge, so that the inlet has moved southward approximately twenty yards per year.

Absecon Inlet, which separates Brigantine Beach from Absecon Beach, has encroached upon the latter about four hundred yards in twenty years; and the ocean front of that portion of Absecon Beach which is occupied by Atlantic City extended in 1855 nearly half a mile farther east than it did in 1885. About 1875 jetties were built which arrested the action of the tidal currents, and, the wear of the shore being thus prevented, a considerable area was restored.

Submerged tree-stumps and other evidences of a subsidence of the coast may be found on the beaches and the salt meadows, but a detailed enumeration of them would be beyond the scope of the present article.

In Cape May County the depression has not been less than twenty feet, and has possibly been much greater. The evidence of some old buildings on the shore of Delaware Bay suggests a subsidence of about four feet during the last two centuries.

It is doubtful whether depression *alone* has caused the wear of the coast. A comparison of the present outline of Holly Beach with that determined by a survey in 1772 shows an accretion on the south and east, since the latter date, more than three and a half miles long and averaging three eighths of a mile in width, and on many other beaches a similar growth has taken place. During the past five years the ocean has rapidly encroached upon these beaches, while the subsidence of the coast, so far as we know, has been uniform throughout the past two centuries. It would appear, therefore, that the growth and decay of the beaches

are more dependent upon the action of the ocean currents and winds than upon other agencies. Unquestionably the depression of the coast renders the beaches more subject to overflow and erosion by the waves and currents; but the evidence at many points shows that the latter are capable of forming large areas of beach where the conditions of their existence and action favor construction rather than destruction. While these currents act as at present, the cost of preventing the ravages of the sea, by the methods commonly in use, would probably be much greater than the value of the land protected, for the fine sand is so unstable when wet that bulkheads and breakwaters are quite ephemeral.

After an extended examination of the various systems of shore defense in use between Sandy Hook and Cape May, it appears to the writer that the only effectual means of protection is the construction of jetties extending far enough from the shore to intercept the currents which carry away the sand loosened by the waves. Such jetties have added a large area to the territory of Atlantic City, and have protected the shore at Cape May; no doubt they would be effective everywhere if properly constructed.

The experience of the past ten years on the New Jersey coast shows conclusively that the ocean front is not fit for building purposes, for it is impossible to protect a house near the water's edge from injury or destruction in the heaviest storms. The height and force of the waves in such a tempest as that of September 10 and 11, 1889, render them irresistible to any body or structure which nature or art has yet produced, and anything within their reach must suffer. The immediate water-front is only available for parks; and, if devoted to this use, when protected from the erosive action of the currents by suitable jetties, would remain a neutral ground which, in fair weather, would afford numberless attractions to the occupants of dwellings placed far enough from the strand to be out of reach of the storm-waves.

Property-owners along the ocean front of the beaches have generally made the mistake of supposing that the domain of the Atlantic was bounded by the high-water mark of the spring tides. Any one who should build a dwelling on the strand below ordinary high-water mark would be considered lacking in common sense, yet it is scarcely less foolish to build within reach of the storm-waves. It is, of course, true that many cottages are now much nearer the water's edge than they were a few years ago. This is due to the wear of the shore by currents already described as flowing parallel to it and removing the sand which the waves have loosened. If the action of these currents should be stopped—and there is good evidence to show that a system of jetties would intercept them and cause them to drop their stolen load of

sand—the wear of the shore would be arrested and the yearly encroachments of the ocean would cease.

With regard to the inundation of Atlantic City by the sea in the great September storm of 1889 it should be said that this catastrophe ought not to be considered very wonderful, since the greater portion of the city is less than ten feet above mean tide, and the highest point recorded by the New Jersey State Survey is only thirteen feet above that level. As ordinary tides rise a foot above this plane, and spring tides nearly two feet, it is evident that a prolonged easterly storm would soon cause a considerable area to be overflowed. Since the bays and channels which lie between the beach and the mainland are almost completely landlocked and the inlets are relatively narrow, the water-level is soon raised to a height of two or three feet above the meadows, and this is sufficient to cover most of the railroad tracks. To be sure, no such inundation as the recent one has occurred since Atlantic City became a place of importance, nor do the old residents on the coast remember such a storm in former years; but it is evident that, while the beaches were uninhabited, such a storm as the one in question would attract less attention, since it would cause little if any loss of property.

The genesis of the beaches is still a matter for speculation, but it may be safely affirmed that they originated as sand-bars, formed under water by wave and current action. How these bars were brought above water, so that the wind could exert its constructive power, is uncertain. A plausible hypothesis is, that while the ocean was breaking on the mainland shore and forming the Quaternary terraces, which may be seen there, sand-bars were made under water, and that the continental elevation which raised these terraces to their present position from twenty-five to eighty feet above tide, brought these sand-bars above water into a horizon of *Æolian* action. Once above the sea, the beaches would maintain their existence. A continued elevation of the coast would add to their seaward extent and a depression would cause a westward recession until they were brought to rest by contact with the mainland shore. In New Jersey the latter condition may be observed between Long Branch and Point Pleasant and also at Cape May.

So far as it is known to the writer, the only way in which a beach can be entirely destroyed is by an inlet shifting its position. In this case the beach obliterated is replaced by the extension of an adjacent beach.

Of the beaches south of New Jersey not enough is known to the writer to permit of a detailed biographical sketch. Their form and structure show that they have been subject to the same formative agencies and vicissitudes as those already described. In addition

to the Georgia sea-islands of *ante-bellum* fame, may be mentioned as familiar examples the barriers which in Virginia and North Carolina separate Albemarle and Pamlico Sounds from the ocean; in Florida, Amelia Island on which is built the city of Fernandina; Anastasia Island, in front of St. Augustine; and the beaches which separate Halifax and Indian Rivers from the Atlantic. The last-named rivers are the lagoons which separate the barriers from the mainland shore. Lake Worth is one of these lagoons, of which the inlet has been closed.

To what extent the Florida Keys may be included in the category of barrier beaches must be decided by future investigation. Key West is evidently a wave-built sand-bar composed of fragments of coral, molluscan shells, and foraminifera, and it seems likely that Cayo Largo and others of that type may be of similar origin. The coquina deposits of the vicinity of St. Augustine are also wave-formed.

The hypothesis of Prof. Louis Agassiz, that the Florida Keys are all of organic origin—i. e., that they were formed by the growth of coral reefs—may be true so far as the determination of their location and direction. A submerged reef of coral may have formed a nucleus on which the waves and currents deposited a load of calcareous sand, but the superficial portion is evidently similar in origin to that of the beaches farther north.

Barrier beaches are found on all the sea-coasts of the world where opportunity for their growth has been afforded, and those of New Jersey may be regarded as types of these formations in all their essential features.

